nected, by means of the wires beneath the base, with the two other and ordinary vertical springs of the instrument, so that by turning the handle they may be disconnected from the studs and connected with those springs, and through them, the axis and standards, with the voltaic cell, and receive a current in either direction, according to the position of the handle. The sketch represents the handle and axis in the above-mentioned first position, with the two wires of the electroscope metallically connected together, but insulated from the cell.

The usual form of the electroscope I have employed is represented in fig. 2. A is a wooden base, B a wooden upright board fixed to it. C is the situation of the reverser. D a microscope, capable of vertical and horizontal movement, having a magnifying power of about 30 to 50 diameters, and provided with a "spider-line." E is a grooved piece of wood fixed to the upright stand. F a wooden slide, with a moveable scale, G, worked by a metal rack H, and pinion with handle, I. J is the capillary, supported by a perforated little brass shelf, K. L is the pressure-chamber. M the glass tube containing the compensating column of mercury. N a thin glass tube, about 5 millims. bore, containing the mercury and conducting solution. O and P are the terminal platinum wires for attachment to the screws of the reverser. Q is a strong clip, shown separate from the instrument. R is a metal support for the clip. S is a moveable slide of cork, carrying a very fine hair, T, for indicating the position of the meniscus. It is not usually necessary to measure the amount of movement of the meniscus. Some cotton wool is placed in the cup, U, and the cup is covered with a lid to exclude dust. A strip of white paper is affixed behind the capillary portion of the tube to form a white background, and the instrument requires to be used in a good light.

Having found by additional experiments that in certain cases the mercury moves in an opposite direction to the electric current, I am now engaged in examining that fact, and in completing an investigation of the causes and conditions of the movements.

VII. "Chemico-Electric Relations of Metals in Solutions of Salts of Potassium." By G. Gore, LL.D., F.R.S. Received December 8, 1879.

The following experiments were made with the object of determining the chemico-electric positions of various metals, &c., in solutions of salts of potassium of various strengths, and at different temperatures; and also with the intention of ascertaining, by the aid of Lippmann's

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capillary electrometer, the quantitative differences of electromotive force between each two consecutive metals, and thus to construct a series of tables of electromotive forces of the particular solids and liquids employed. But as after making many attempts I was unable to construct such a form of that electrometer as might be relied upon as an accurate measuring instrument, I abandoned the object of measuring the electromotive differences, and proceeded no farther than simply determining the order of such differences in each particular solution. Although I have not been able to carry out the examination as far as I intended, I venture to submit the results to the Royal Society, in the hope that if published they may be of use to other investigators, as similar tables upon a less extensive scale have already proved.

As the true electrical relations of metals in liquids depends largely upon the purity of the substances, I beg to state that the metals and salts employed were, in nearly all cases, the purest obtainable. The tellurium, mercury, and antimony were very highly purified by me; the silicon was prepared by fusing some fine crystals, which I had previously digested with pure hydrofluoric acid, hydrochloric acid, and nitric acid separately. The gold, silver, platinum, palladium, iridium, rhodium, cobalt, tin, and cadmium, were obtained from Messrs. Matthey and Co., and were the purest they prepare. The nickel was refined by Sir J. Mason, and was of a high degree of purity; it had been rolled into a thin strip. The carbon was a rod of a Jablochkoff's candle. The indium was a portion of one of the ingots exhibited at the Paris Exhibition by its discoverers. The gallium was presented to me by M. Lecoq de Boisbaudran, and said to be "nearly pure except traces of zinc." The thallium was supplied to me by Messrs. Hopkin and Williams. The magnesium was probably very pure, and was obtained from the Magnesium Metal Company, from whom I also obtained the bismuth, said to be "highly purified." The aluminium, copper, lead, iron, and zinc wires were of the ordinary qualities.

The salts employed were of considerable purity, and in every case were dissolved in distilled water. To remove any trace of free iodine or acid from the solutions of potassic iodide, or any trace of soluble sulphide contained in those of cyanide of potassium, they were previously well stirred with a rod of aluminium or magnesium.

Every investigator who has made experiments of the present kind is aware that temporary reversals of the current frequently occur in such cases. When the reversals took place immediately upon immersion, the first current was not regarded, because it was probably due to a momentary change of surface tension or of temperature, caused by the physical contact of the solid and liquid prior to chemical action.

A sufficient number of different strengths of solution of each salt were employed to supply a large number of determinations, so as to

enable curves to be drawn showing the variation of relative electric positions of different metals with the variations of strength of the liquid. Such curves were drawn, compared with each other, and conclusions inferred respecting similar metals or groups of metals.

In the following tables the numbers at the top of each column represent the numbers of grains of the particular salt dissolved in the quantity of water stated. The amount of water employed in the solutions of the first six tables was 50 cub. centims., and in Tables VII and VIII it was 800 grains.

The specimen of gallium not having been obtained in sufficient time for the whole of the experiments, it was not employed in Tables I and VII and part of Table III. Being also easily fusible it could not be used in hot solutions.

Table No. I.—Potassic Chloride Solutions at 55° F.

Grains 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	Sat. sol.
Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn
Cd	Tl	Cd	Al	Cd	Cd	Cd	Cd	Cd	Cd	Cd
Tl	Al	Tl	Cd	Al	Al	Al	Al	Al	Al	Al
Al	Cd	Al	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl
In	In	In	In	In	In	In	In	In	In	In
Sn	Pb	Fe	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
Pb	Fe	Pb	Fe	Sn	Sn	Sn	Sn	Sn	Sn	Sn
Si	Sn	Sn	Sn	Fe	Fe	Fe	Fe	Fe	Fe	Fe
Fe	Co	Si	Si	Co	Co	Co	Co	Co	Co	Co
Co	Si	Co	Co	Si	Si	Si	Sb	Si	Si	Cu
Cu	Sb	Ni	Sb	Sb	Sb	Sb	Cu	Sb	Sb	Sb
Sb	Bi	Cu	Cu	Bi	Cu	Cu	Ni	Cu	Cu	Bi
Bi	Cu	Sb	Ni	Cu	Bi	Bi	Si	Ni	Bi	Si
Hg	Ni	Bi	Bi	Ni	Ni	Ni	Bi	Bi	Ni	Ni
Ni	Te	Te	Te	Te	Te	Te	Te	Te	Ag	Ag
Te	Ir	Hg	Ag	Hg	Ag	Ag	Ag	Ag	Te	Te
Ir	Hg	Pd	Pd	Au	Hg	Ir	Hg	Hg	Hg	Hg
Rh	Rh	Ag	Hg	Ag	Pd	Hg	Ir	Ir	Ir	Ir
Pd	Pd	Au	Au	Pd	Ir	Au	Au	Au	Au	Pd
Au	Au	Ir	Pt	Ir	Au	Pd	Pd	Pd	Pd	Au
Ag	Ag	Pt	Ir	Pt	Pt	Pt	Pt	Pt	Pt	Rh
Pt	Pt	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Pt
C	C	C	C	C	C	C	C	C	C	C

Temporary reversals occurred with Cd and Al in the solution of 200 grs.; Co and Fe in 200 and 240; Pb and Fe in 10; Sb and Cu in 10; Cu and Ni in 20; Tl and Cd in 1; Si and Bi in 160; and Ir and Au in the 160 grs. solution.

Table No. II.—Potassic Chloride Solutions at 100° F.

Grains 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	Sat. sol.
Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn
Tl	Tl	Tl	Tl	Cd	Cd	Cd	Cd	Cd	Cd	Cd
Al	Al	Cd	Al	Al	Al	Al	Al	Al	Al	Al
Cd	Cd	Al	Cd	Tl	Tl	Tl	Tl	Tl	Tl	Tl
In	In	In	In	In	In	In	In	In	In	In
Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
Sn	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Sn	Sn	Sn
Fe	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Fe	Fe	Fe
Si	Co	Co	Co	Co	Co	Co	Co	Co	Co	Co
Co	Si	Si	Si	Sb	Si	Si	Sb	Sb	Sb	Sb
Sb	Sb	Sb	Sb	Bi	Sb	Sb	Si	Cu	Cu	Cu
Bi	Bi	Ni	Bi	Si	Cu	Cu	Cu	Bi	Bi	Bi
Cu	Cu	Bi	Cu	Cu	Bi	Bi	Bi	Si	Si	Si
Hg	Ni	Cu	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni
Ni	Te	Te	Te	Te	Te	Te	Te	Te	Ag	Ag
Te	Ir	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Te	Te
Ir	Hg	Pd	Hg	Hg	Ir	Ir	Hg	Hg	Hg	Hg
Rh	Rh	Hg	Ir	Ir	Hg	Hg	Ir	Ir	Ir	Ir
{ Pd	Pd	Au	Rh	Rh	Pd	Pd	Au	Au	Au	Au
{ Au	{ Au	Ir	Pd	Au	Au	Rh	Pd	Pd	Pd	Pd
Ag	{ Ag	Rh	Au	Pd	Pt	Au	Pt	Pt	Rh	Pt
Pt	Pt	Pt	Pt	Pt	Rh	Pt	Rh	Rh	Pt	Rh
C	C	C	C	C	C	C	C	C	C	C

Table No. III.—Potassic Bromide Solutions at 55° F.

Grains. 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	280,	320,	360,	Sat. sol.
Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn
Tl	Tl	Tl	Cd	Cd	*Cd	*Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd
Cd	Cd	Cd	Tl	Tl	Tl	Tl	*Tl	*Tl	*Tl	*Tl	*Tl	*Tl	*Tl
In	In	In	In	In	In	Al	Al	Al	Al	Al	Al	Al	Al
Al	Al	Al	Al	Al	Al	In	In	In	In	In	In	In	Pb
Fe	Fe	Fe	Fe	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	In
Pb	Pb	Pb	Pb	Fe	Fe	Fe	Fe	Sn	Sn	Sn	Sn	Sn	Sn
Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Fe	Fe	Fe	Fe	Fe	Fe
Co	Co	Co	Co	Co	Co	Co	Co	Co	Co	Co	Cu	Cu	Cu
Sb	Sb	Sb	Sb	Sb	Sb	Sb	Cu	Cu	Cu	Cu	Co	Co	Co
Si	Si	Si	Si	Si	Si	Cu	Sb	Sb	Sb	Sb	Sb	Sb	Sb
Bi	Bi	Bi	Bi	Bi	Bi	Si	Si	Si	Si	Si	Si	Si	Si
Ni	Ni	Cu	Cu	Cu	Cu	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi
Te	Cu	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ag	Ag	Ag	Ag	Ag
Cu	Te	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ni	Ni	Ni	Ni	Ni
Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg
Ag	Ag	Te	Te	Te	Te	Te	Te	Te	Te	Te	Pd	Pd	Pd
Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Te	Au	Au
Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Au	Au	Au	Te	Te
Rh	Au	Au	Au	Au	Au	Au	Au	Au	Pt	Pt	Pt	Pt	Pt
Au	Rh	Rh	Rh	Pt	Rh	Pt	Pt	Pt	Ir	Ir	Ir	Ir	Ir
Pt	Pt	Pt	Pt	Rh	Pt	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh
C	C	C	C	C	C	C	C	C	C	C	C	C	C

Table No. II.—Temporary reversals occurred with Cd and Al in solutions of 40, 160, and 200 grs.; Sn and Fe in 40 and 160; Cu and Ni in 20; Si and Cu in 160; and Pd and Pt in 160.

Table No. III.—Temporary reversals occurred with In and Al in solutions of 5, 10, and 20 grs.; Al and Cd in 40; Tl and Al in 160 and 200; Fe and Sn in 1 and 160; Fe and Pb in 1; Fe and Co in 280; Fe and Pd in 10; Au and Pd in 280; Pd and Te in 80 and 200; Au and Rh in 20; Ir and Au in 40, 120, and 160; Bi and Cu in 120; Bi and Si in 160 and 200; and Ni and Ag in 240.

The position of gallium in various columns of this table is indicated by a *; its position is immediately *above* the star.

Table No. IV.—Potassic Bromide Solutions at 100° F.

Grains. 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	280,	320,	360,	Sat. sol.
Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn
Tl	Tl	Tl	Tl	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd
Cd	Cd	Cd	Cd	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl
In	In	In	In	In	In	Al	Al	Al	Al	Al	Al	Al	Al
Al	Al	Al	Al	Al	Al	In	In	In	In	In	In	In	In
Pb	Pb	Fe	Sb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
Sn	Fe	Pb	Fe	Fe	Fe	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn
Fe	Sn	Sn	Sn	Sn	Sn	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe
Co	Co	Co	Co	Co	Co	Co	Co	Co	Co	Co	Cu	Cu	Cu
Sb	Sb	Sb	Sb	Sb	Sb	Sb	Cu	Cu	Cu	Cu	Co	Co	Co
Si	Si	Si	Si	Si	Si	Cu	Sb	Sb	Sb	Sb	Sb	Sb	Sb
Bi	Bi	Bi	Bi	Bi	Cu	Si	Si	Si	Si	Si	Si	Si	Si
Ni	Ni	Cu	Cu	Cu	Bi	Bi	Bi	Bi	Bi	Bi	Ag	Bi	Ag
Te	Cu	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ag	Ag	Bi	Ag	Bi
Cu	Te	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ni	Ni	Ni	Ni	Ni
Ag	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg
Hg	Ag	Te	Te	Te	Te	Te	Te	Te	Te	Te	Pd	Pd	Pd
Ir	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Te	Au	Au
Pd	Ir	Ir	Ir	Ir	Au	Ir	Ir	Au	Au	Au	Au	Te	Te
Rh	Au	Au	Au	Au	Ir	Au	Au	Pt	Pt	Ir	Pt	Pt	Pt
Au	Rh	Pt	Rh	Pt	Rh	Rh	Pt	Ir	Ir	Pt	Ir	Ir	Ir
Pt	Pt	Rh	Pt	Rh	Pt	Pt	Rh	Rh	Rh	Rh	Rh	Rh	Rh
C	C	C	C	C	C	C	C	C	C	C	C	C	C

Temporary reversals occurred with In and Al in solutions of 5, 10, 20, 40, and 80 grs.; In and Pb in 200; Fe and Sn in 20, 80, and 240; Fe and Co in 1; Au and Pd in 80; Pd and Te in 120 and 280; Au and Rh in 5; Ir and Au in 120; Ir and Pt in 200; Ni and Bi in 200; Co and Cu in 240; Ag and Si in 320, and in the saturated solution.

Table No. V.—Temporary reversals occurred with Co and Fe in solutions of 5, 10, 20, and 160 grs.; Ni and Si in 240, 320, 360, and 500; Ni and Pd in 800, 1,000, and saturated solution; In and Fe in 240 and 320; Sb and Ag in 40 and 200; Sb and Hg in 160; Cu and

Table No. V.—Potassic Iodide Solutions at 60° F.

Grains 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	280,	320,	360,	400,	500,	600,	800,	1,000,	Sat. solution.
Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn
Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd
Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga	Ga
Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl
Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al
Pb	Pd	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn
In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In
Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Cu	Cu	Cu	Cu	Cu
Co	Co	Co	Co	Co	Co	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Ag	Ag	Ag	Ag	Ag
Sb	Sb	Cu	Cu	Cu	Cu	Co	Ag	Sb	Co	Ag	Ag	Ag	Ag	Fe	Fe	Hg	Hg	Sb
Cu	Cu	Sb	Sb	Sb	Sb	Sb	Co	Ag	Sb	Co	Sb	Sb	Sb	Sb	Sb	Fe	Sb	Fe
Si	Si	Si	Si	Ag	Ag	Ag	Sb	Co	Ag	Sb	Co	Co	Hg	Hg	Hg	Sb	Fe	Hg
Bi	Bi	Ag	Ag	Si	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Hg	Co	Co	Co	Bi	Co	Co
Ni	Ag	Bi	Hg	Hg	Si	Si	Si	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Co	Bi	Bi
Ag	Ni	Ni	Bi	Bi	Bi	Bi	Ni	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si
Hg	Hg	Hg	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni
Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Au	Pd	Pd
Au	Au	Te	Au	Au	Au	Te	Te	Au	Au	Au	Au	Au	Te	Te	Au	Pd	Te	Te
Te	Te	Au	Te	Te	Te	Au	Au	Te	Pt	Te	Pt	Te	Pt	Pt	Pt	Te	Au	Au
Pt	Pt	Pt	Pt	Pt	Pt	Pt	Pt	Pt	Te	Pt	Te	Pt	Ir	Ir	Te	Pt	Pt	Pt
Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Rh	Rh	Ir	Ir	Ir	Ir
Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	C	C	Rh	Rh	Rh	Rh
C	C	C	C	C	C	C	C	C	C	C	C	C			C	C	C	C

Table No. VI.—Potassic Iodide Solutions at 100° F.

Grains 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	280,	320,	360,	400,	500,	600,	800,	1,000,	Sat. solution.
Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn	Zn
Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd
Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl	Tl
Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al	Al
Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn	Sn
In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In	In
Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Cu	Cu	Cu	Cu	Cu	Cu
Co	Co	Co	Co	Co	Co	Co	Cu	Cu	Cu	Cu	Cu	Cu	Ag	Ag	Ag	Ag	Ag	Ag
Sb	Cu	Cu	Cu	Cu	Cu	Sb	Co	Co	Co	Co	Ag	Ag	Fe	Fe	Fe	Sb	Fe	Sb
Cu	Si	Sb	Sb	Sb	Sb	Ag	Sb	Sb	Sb	Ag	Sb	Sb	Sb	Sb	Sb	Fe	Hg	Fe
Si	Ag	Si	Ag	Si	Ag	Hg	Ag	Ag	Ag	Sb	Co	Co	Hg	Hg	Hg	Hg	Sb	Hg
Bi	Ni	Hg	Si	Ag	Hg	Bi	Hg	Hg	Hg	Hg	Hg	Hg	Co	Co	Co	Co	Co	Co
Ni	Bi	Bi	Bi	Bi	Si	Si	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi
Ag	Hg	Ni	Hg	Hg	Bi	Ni	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si	Si
Hg	Pd	Pd	Ni	Ni	Ni	Pd	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni	Ni
Pd	Au	Te	Pd	Pd	Pd	Te	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd
Au	Te	Au	Te	Au	Au	Au	Au	Au	Au	Au	Au	Au	Au	Au	Au	Au	Te	Te
Te	Pt	Pt	Au	Te	Te	Pt	Te	Te	Te	Te	Te	Te	Te	Te	Pt	Te	Au	Au
Pt	Ir	Ir	Pt	Pt	Pt	Ir	Pt	Pt	Pt	Pt	Pt	Pt	Pt	Pt	Te	Pt	Pt	Pt
Ir	Rh	Rh	Ir	Ir	Ir	Rh	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir
Rh	C	C	Rh	Rh	Rh	C	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh
C			C	C	C		C	C	C	C	C	C	C	C	C	C	C	C

Table No. VII.—Potassic Cyanide Solutions at 55° F.

Grains 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	280,	320,	360,	400,	500,	Saturated solution.
Mg	Al	Mg	Mg	Al	Al	Al	Mg	M	Mg	Mg	Mg	Mg	Zn	Zn	Zn
Zn	Mg	Zn	Zn	Mg	Zn	Zn	Al	Zn	Zn	Zn	Zn	Zn	Cu	Mg	Cu
Al	Zn	Al	Al	Zn	Cu	Mg	Zn	Al	Cu	Cu	Cu	Cu	Mg	Cu	Mg
Cd	Cu	Cu	Cu	Cu	Mg	Cu	Cu	Cu	Al	Al	Al	Al	Cd	Cd	Cd
Cu	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Al	Al	Al
Sn	Sn	Au	Au	Pd	Au	Ag	Au	Au	Au	Ag	Ag	Ag	Pd	Pd	Pd
Tl	Co	Ag	Pd	Ag	Pd	Au	Pd	Ni	Ag	Au	Au	Au	Ni	Ag	Au
Pb	Ni	Sn	Ag	Au	Ag	Pd	Ag	Ag	Pd	Pd	Ni	Ni	Au	Au	Ag
Co	Ag	Co	Co	Co	Ni	Ni	Ni	Pd	Ni	Ni	Pd	Pd	Ag	Ni	Ni
In	In	Ni	Ni	Ni	Co	Hg	Sn	Sn	Sn	Sn	Hg	Sn	Sn	Sn	Sn
Au	Au	Pd	Sn	Pb	Pb	Co	Pb	Hg	Hg	Hg	Sn	Hg	Pb	Hg	Hg
Ag	Tl	Tl	Tl	Tl	Tl	Sn	Co	Pb	Pb	Pb	Pb	Pb	Co	Pb	Co
Sb	Hg	Pb	Pb	Hg	Hg	Pb	Hg	Co	Co	Co	Co	Co	Hg	Co	Pb
Ni	Pb	In	Hg	Sb	Sb	In	Tl	Sb	Sb	Tl	Sb	Tl	Tl	Tl	In
Hg	Si	Sb	In	Sn	Sn	Tl	In	Tl	Tl	Sb	Tl	Sb	Sb	In	Tl
Pd	Fe	Hg	Sb	In	In	Sb	Sb	In	In	In	In	In	In	Sb	Te
Fe	Pt	Bi	Bi	Bi	Bi	Bi	Te	Te	Te	Te	Te	Te	Te	Te	Sb
Bi	Pd	Te	Fe	Te	Te	Te	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi	Bi
Pt	Sb	Fe	Si	Si	Fe	Fe	Si	Si	Si	Si	Fe	Fe	Fe	Fe	Fe
Te	Bi	Si	Te	Ir	Ir	Si	Fe	Pt	Fe	Fe	Si	Si	Si	Si	Si
Si	Ir	Pt	Pt	Fe	Si	Ir	Ir	Fe	Pt	Pt	Pt	Pt	Pt	Pt	Pt
Ir	Te	Ir	Ir	Pt	Pt	Pt	Pt	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir
Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh
C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Ag in 160; Tl and Al in 1,000; and with Fe and Hg in the saturated solution.

Table No. VI.—Temporary reversals occurred with Co and Fe in solutions of 1, 5, 10, 40, and 80 grs.; Si and Ni in 160, 200, 280, 320, 360, 400, and 500; Pd and Ni in 800, 1,000, and saturated solution; Hg and Fe in 800; In and Fe in 200; Si and Ag in 10; and Sb and Cu in the 5 grs. solution.

Table No. VII.—Temporary reversals occurred with Zn and Mg in solutions of 40, 80, 120, 160, 240, 280, and 360 grs.; Al and Mg in 40, 120, 160, 240, and 320; Cd and Mg in 400; Cu and Mg in 80, 400, and 500; Pd and Mg in 80; Al and Zn in 5, 40, 80, 120, and 160; Cu and Zn in 80 and 160; Cu and Al in 10, 20, 80, 160, 200, and 280; Cd and Al in 10, 20, 240, 280, and 320; Cd and Cu in 5, 10, 20, and 160; Au and Ag in 10, 20, 80, 160, 240, 280, and 500; Pd and Ag in 10, 40, and 120; Sn and Pd in 200; Sb and Pd in 5; Tl and Pd in 10; Bi and Pd in 1; Fe and Pd in 1; Ni and Pd in 160, 200, and 320; Au and Sn in 20; Ni and Ag in 5, 200, 400, and saturated solution; Co and Ag in 80; Sn and Ag in 5 and 10; Sb and Ag in 1; Ni and Au in 80 and 120; Ni and Sn in 20, 80, 160, 280, and 500; Ni and Pt in 5; Ni and Pb in 10, 40, and 80; Pb and Tl in 10, 20, and 40; Hg and Pb in 160; In and Pb in 5 and 160; In and Bi in 320; Sb and Pb in 240; Sb and Tl in 200 and 500; Sn and In in 80; Sn and Sb in 80; Fe and Bi in 40, 200, 320, 360, and saturated solution; Fe and Si in 160, 200, 500, and saturated solution; Sb and Tl in 280 and 320; Bi and Te in 280; Sb and Bi in 5; In and Au in 5; In and Hg in 10; Tl and Hg in 5; Sn and Pb in 500; Sb and In in 500; Sb and Te in 500; Hg and Sn in saturated solution; Co and Ni in 80, 200, 240, and saturated solution; Co and Pb in 240, 280, and 500; Co and Sn in 280 and saturated solution; Co and Pb in 240, 280, and 500; Co and Sn in 280 and saturated solution; Co and Sb in 360; Co and Tl in 360; Pt and Ir in 10, 80, 160, 240, and 400; Pt and Si in 240, 320, and 400; Fe and Pt in 280 and 360; Pt and Rh in 80; and C and Rh in 280.

Table No. VIII.—Temporary reversals occurred with Zn and Mg in solutions of 120, 200, 240, 280, 320, and 400 grs.; Al and Mg in 40, 200, 320, and saturated solution; Cd and Mg in 500; Cu and Mg in 40, 280, and 320; Al and Zn in 1, 10, 120, 160, and 240; Cu and Al in 10, 20, 160, 200, 320, and 360; Cd and Al in 10; Au and Ag in 240 and saturated solution; Sn and Pd in 200, 500, and saturated solution; Tl and Pd in 10; Au and Pd in 10; Au and Sn in 160 and 240; Ni and Ag in 80, 400, and 500; Sn and Ag in 400 and 500; Ni and Sn in 360; Ni and Pb in 20, 200, and 240; Hg and Pb in 120; Fe and Bi in 500; Fe and Te in 20, 120, and 160; Si and Te in 160; Tl and In in saturated solution; Co and Ni in 1, 80, 120, and saturated solution; Co and Pb in 320 and 360; Co and In in 320 and 400; Co and Sn in

Table No. VIII.—Potassic Cyanide Solutions at 100° F.

Grains 1,	5,	10,	20,	40,	80,	120,	160,	200,	240,	280,	320,	360,	400,	500,	Saturated solution.
Mg	Mg	Mg	Mg	Zn	Zn	Al	Mg	Zn	Mg	Zn	Zn	Mg	Zn	Zn	Zn
Al	Zn	Zn	Zn	Al	Al	Zn	Zn	Mg	Al	Mg	Mg	Zn	Mg	Cu	Cu
Zn	Cd	Al	Al	Mg	Mg	Cu	Al	Al	Zn	Cu	Al	Al	Cu	Al	Al
Cd	Al	Cd	Cu	Cu	Cu	Mg	Cu	Cu	Cu	Al	Cu	Cu	Al	Mg	Mg
Cu	Co	Cu	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd
Sn	Cu	Sn	Pd	Pd	Pd	Au	Pd	Sn	Pd	Pd	Pd	Pd	Au	Au	Sn
Pb	Ni	Pd	Sn	Ni	Au	Pd	Au	Pd	Sn	Sn	Au	Ag	Pd	Sn	Pd
Tl	Sn	Au	Au	Au	Ni	Ag	Sn	Au	Au	Au	Sn	Sn	Ni	Pd	Au
Pd	In	Ag	Ag	Ag	Ag	Ni	Ag	Ag	Ag	Ag	Ag	Au	Sn	Ni	Ag
In	Au	Co	Co	Co	Pb	Sn	Ni	Ni	Ni	Ni	Ni	Ni	Ag	Ag	Ni
Au	Tl	Ni	Ni	Pb	Co	Co	Co	Co	Hg	Hg	Hg	Pb	Pb	Hg	Hg
Ag	Ag	Tl	Pb	Tl	Tl	Pb	Pb	Pb	Pb	Co	Pb	Hg	Hg	Co	Co
Ni	Pb	Pb	Hg	Sn	Hg	Hg	Hg	Hg	Tl	Pb	In	Co	Tl	Sb	Pb
Co	Pd	In	Tl	Hg	Sn	Tl	Tl	Tl	Co	Tl	Tl	Tl	In	Pb	Tl
Hg	Hg	Sb	In	Sb	Sb	Sb	Sb	Sb	Sb	Sb	Sb	In	Co	Tl	In
Sb	Si	Hg	Sb	In	In	In	Bi	In	In	In	Co	Sb	Sb	In	Sb
Fe	Sb	Bi	Bi	Bi	Bi	Bi	In	Bi	Te	Bi	Bi	Fe	Fe	Fe	Bi
Bi	Bi	Fe	Si	Si	Te	Te	Te	Te	Bi	Te	Te	Bi	Bi	Bi	Fe
Si	Fe	Te	Te	Fe	Fe	Fe	Fe	Si	Fe	Fe	Fe	Te	Te	Te	Te
Te	Te	Si	Fe	Pt	Si	Si	Si	Fe	Si	Si	Si	Si	Pt	Si	Si
Ir	Ir	Ir	Pt	Te	Ir	Pt	Pt	Pt	Pt	Pt	Pt	Pt	Si	Pt	Pt
Pt	Pt	Pt	Ir	Ir	Pt	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir	Ir
Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh	Rh
C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

5 and 120; Co and Sb in 320 and 400; Co and Tl in 360 and 400; Co and Hg in 320, 360, and 500; Pt and Si in 10; and C and Rh in the 5 grs. solution.

Table No. IX.—In Fused Cyanide of Potassium.

The following was the order obtained by immersing the various elementary substances in cyanide of potassium in a fused state; the first substance being the most positive: magnesium, zinc, aluminium and platinum, nickel, iron, silver, iridium, gold, rhodium, carbon, palladium, cobalt, antimony.

From the notes appended to the foregoing tables, it may be observed—1st, that by far the greatest number of momentary reversals of current took place in the cyanide solutions, especially in the cold ones; 2nd, that the proportions of such reversals to the number of solutions employed were not greatly different in the chloride, bromide, and iodide of potassium; and 3rd, the reversals were not confined to the more electro-positive metals. The most numerous reversals in the cold solutions of potassic cyanide took place with nickel (26), aluminium (21), silver (18), platinum (16), magnesium (15), and zinc (14); and in the hot solutions, with aluminium (16), magnesium (14), and zinc (11); whilst in the cold iodide solutions the most frequent ones were nickel (7), iron (6), silicon (4), and cobalt (4); and in the hot liquids, nickel (10), silicon (8), iron (7), and cobalt (8); most of these occurred in the strong solutions. With the cold bromide mixtures reversals occurred with aluminium (6), iron (5), gold (5), and palladium (4); with the same liquids hot, indium (6), aluminium (5), and iron (4). And with the chloride solutions cold, iron (3); and hot, aluminium (3), and cadmium (3). The behaviour of particular pairs of metals in different liquids with regard to reversals may be ascertained by inspection of the notes.

Certain other general effects were also observed in the results. 1st. Gas carbon was electro-negative to all other bodies in all the solutions employed, whether cold or hot; concentrated or dilute. 2nd. Rhodium was electro-negative to all substances except carbon, in all solutions of either iodide or cyanide of potassium, of all degrees of concentration, and at each temperature. 3rd. Either rhodium or platinum was negative to all bodies except carbon in all the solutions of chloride or bromide of potassium, whether cold or hot. 4th. Magnesium was positive to all the other substances in all the solutions of potassic chloride, bromide, or iodide, at each temperature. 5th. Either magnesium, aluminium, or zinc, was positive to all other metals in solutions of potassic cyanide, whether cold or hot. Thallium appeared to be the most quickly corroded of any metal in all the solutions, and was most manifestly affected in those of potassic iodide; lead was also acted upon, but to a less extent, in that class of liquids.

By drawing lines through all the positions of each particular metal in the tables of solutions of different strengths of either of the salts employed, it was found that the position of pairs of metals of like properties, such as magnesium and zinc, nickel and cobalt, rhodium and iridium or platinum, lead and tin, &c., often varied together, and described similar curves or lines of variation.

A much greater number of variations of relative electric position of the metals occurred in the cold and hot solutions of potassic cyanide than in either those of the chloride, bromide, or iodide, whether cold or hot, and the amounts of such variations were also much greater in the cyanide solutions.

Agitation of the immersed metals is well known to influence the current. Shaking one of the metals reversed occasionally the direction of the current; palladium was the metal which most frequently manifested this effect. The agitation of that metal rendered it either more negative or less positive in a considerable degree, especially in solutions of potassic chloride and cyanide. In those of the bromide, antimony was the metal the current from which was most affected by shaking. The effect of shaking was less in the iodide solutions than in those of the bromide.

VIII. "On the Spontaneous Segmentation of a Liquid Annulus." By A. M. Worthington, M.A. Communicated by Balfour Stewart, F.R.S., Professor of Natural Philosophy in Owens College, Manchester. Received December 6, 1879.

In seeking an explanation of the appearance of a definite number of lobes in the liquid annulus which is formed at a certain stage of the splash of a drop that has fallen vertically on to a horizontal plate, I was led to make some experiments on the spontaneous segmentation of such an annulus lying on a plate with a view to ascertaining whether the relation that exists between the dimensions of the annulus and the number of drops into which it will spontaneously split, is the same as for a straight cylinder of liquid under similar conditions. Finding that the relation was the same, it then occurred to me that by liberating an annulus in air without contact with any solid, a direct experimental proof might be obtained of the law of segmentation of a free cylinder.

It has been shown mathematically in various ways, and experimentally by M. Plateau, that the equilibrium of a free cylinder of any liquid, under the influence of surface tension only, becomes unstable as soon as the length exceeds π times the diameter; and it has been regarded as a necessary consequence of this that such a cylinder, if